Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

# FLAXMAN ISLAND, A GLACIAL REMNANT

ERNEST DE KOVEN LEFFINGWELL
Flaxman Island, Alaska.

Flaxman Island is located close to the north shore of Alaska, approximately in Lat. 70°, Long. 146°, and a hundred miles west of the international boundary. It is one of the innumerable small islands that fringe the coast between Point Barrow and Demarcation Point. Failing to reach their goal in Banks Land, this island was chosen as the winter quarters of the Anglo-American Polar Expedition, commanded by Capt. Ejnar Mikklesen, and the writer.

A couple of miles to the south lies the mainland, a low tundra plain extending some twenty miles back to the mountains. Both the mountains and the coastal plain are characteristic features of the northern part of Alaska. From Cape Lisburn on the west coast a chain of mountains runs eastward into Canada, separated from the ocean by a plain of greater or less width. At Point Barrow the plain is over a hundred miles wide, but it narrows to the eastward until at Demarcation Point the mountains come within a few miles of the coast.

Opposite Flaxman Island the nearer mountains have an elevation of between three and four thousand feet, but higher peaks can be seen beyond. The map[1] gives seven thousand feet along the Arctic-Yukon divide, but prospectors estimate it higher. From this chain several rivers make their way across the tundra to the Arctic Ocean. The Coville is probably the largest, but the Kugura is reported to be about 280 miles long.[2]

The coastal plain is covered with moss and grass, and with its ponds, lakes, and swamps forms a characteristic tundra. Near the ocean it usually ends in a low mud cliff which seldom reaches a height of thirty feet. Small bays and lagoons, behind sand spits and barrier reefs, fringe the shore, while at a distance of a few miles occurs a nearly continuous chain of islands. With two exceptions known to the writer (Flaxman and Barter Islands, which are tundra) these are exposed portions of a wave-built barrier reef. Inside is a long shallow lagoon along which it is possible for light-draught vessels to make their way for miles, protected from the ice pack.

---

[1] Map of Alaska, *U. S. Geological Survey*, 1904.

[2] Schrader, F. C., Professional Paper, No. 20, p. 31, *U. S. Geological Survey*.

Flaxman Island is about three miles long and half a mile wide, running nearly parallel to the mainland. Its surface is a tundra plain about twenty feet above the sea. Ponds are scattered over the surface, and large crystalline boulders are frequently met with lying half buried in the soil. Immediately over the beach the plain ends in a steep mud cliff which is broken by frequent gullies. The beach itself is studded with boulders which are seen in all stages of being, weathered out of the cliff as it recedes under the action of the elements.

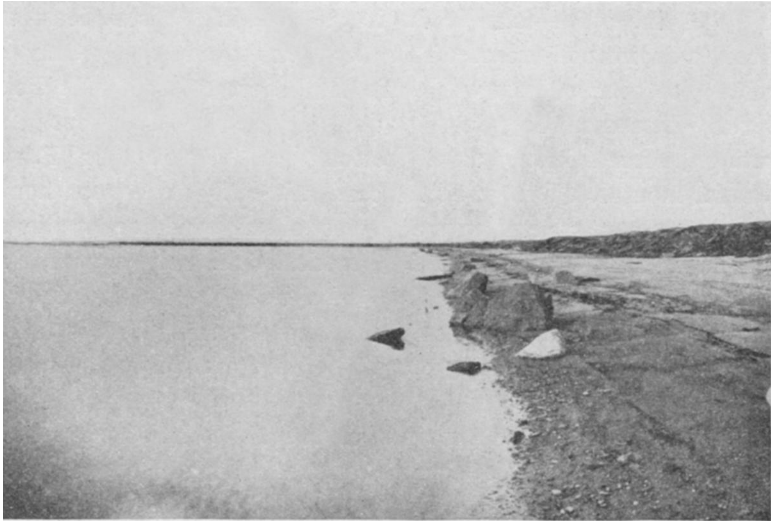

FIG. 1.—A portion of the coast of Flaxman Island.

Where the cliff affords a good exposure, ice is nearly always seen immediately underlying the soil. Usually only a few feet are found, but on the northeast shore there are places showing at least twenty feet. Nowhere is the base of the ice exposed, so no estimate of its thickness can be made. The surface waters have often melted little canyons into the ice by means of which its presence can be traced thirty to forty feet back from the face of the cliff. About thirty yards back, near the winter quarters, the writer found nearly pure fresh water ice, after digging through one foot of soil, and the same amount of frozen clay. It is the intention of the expedition to obtain their winter's supply of fresh water by sinking a shaft down into this ice, at the same time learning something further as to its thickness and constitution.

Its frequent exposure along the cliffs and its presence some distance inland, points to the presumption that the ground-ice formation underlies the whole island. As is the rule in arctic regions, the ground remains permanently frozen to an unknown depth. Only the upper foot or two thaw out during the short summer. At Point Barrow, Lieutenant Ray dug over thirty-five feet down without penetrating the frozen layer. At the bottom a temperature of 12° F. was held for months. This being the case, it is easily understood how a body of ice, once covered with a few feet of soil, would endure a very long time in the Arctic regions. Practically the only way such an island as this can be destroyed, is by wave-cutting at the sides and the consequent direct exposure of the ice to the sun. This is taking place very rapidly on the seaward side, as freshly fallen blocks of peat and ice show.

Good exposures show a mass of clean ice with an occasional discolored band running haphazard across it. There is no apparent stratification, and the ice is very clean as a whole. When the ice is examined closely it is seen to be full of minute air bubbles and to be coarsely granulated; which shows that it could not have been formed by the freezing of a body of standing water. It must be either glacier ice or snow that has become coarsely granulated by great age.

A single glance at the boulders scattered over the surface and weathered out along the beach is at once suggestive of glacial drift. Most of them have the characteristic outlines of glacial boulders, but many are angular from the shattering action of the intense frost. Their lithological heterogeneity is very striking. Among the crystallines it seems as if the whole gamut were run, but the sedimentaries seem to be confined to quartzites and limestones. The quartzites are the most conspicuous—pink, red, and purple; often banded, crossbedded, or conglomeratic. Next come dark crystallines of the gabbro type, then pink granites, then buff limestones. A few moments' search revealed abundant striae, not only on the limestones but on the crystallines as well. A quarter of an hour's walk along the beach showed scores of boulders so definitely striated that any one of them would settle the question of their glacial origin.

It next remains to inquire into the age of the ice. A careful search was made around the whole border of the island, but the base of the ice was nowhere visible. It cannot be denied, then, that some of the boulders might have come from beneath, but many, and probably most, of them came from the few feet of till that lies on top of the ice. Several were seen with ice immediately below them in the face of the cliff. Consequently there seems no escape from the conclusion that the ice is of equal or greater age than the glacial till that lies above it.

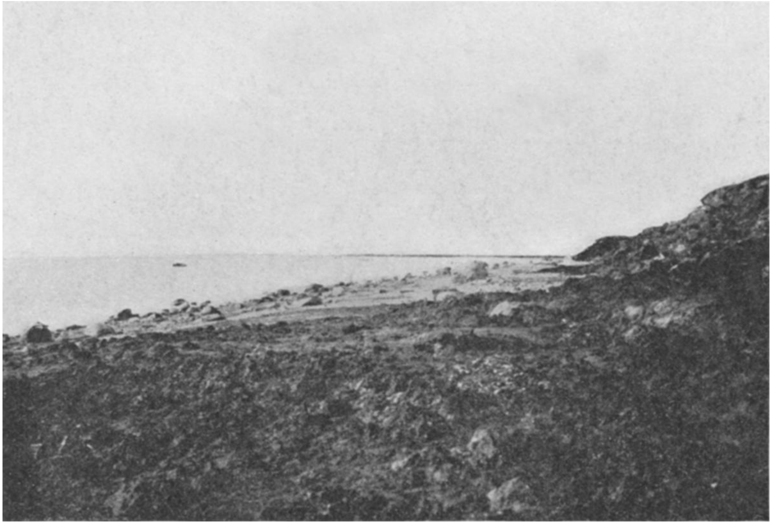

FIG. 2.—Another part of the coast.

Two boulders, approximately ten and fifteen inches in diameter, were found imbedded in the ice itself. The former lay in the lower portion of a few feet of ice exposed in the cliff; the latter, thirty feet back from the face of the cliff, in the vertical wall of clear ice that formed one side of a channel melted to a depth of five feet by the surface waters. We have seen that the ground ice probably underlies the whole island, that it is covered with glacial drift, and contains boulders imbedded within it; so the conclusion is forced upon us that our island is simply a portion of a glacier that has been kept from melting by a thin coating of drift upon its surface.

Naturally the mountains on the mainland to the south are to be looked to for the source of the glacier by which Flaxman Island was formed. As we have said, a chain of mountains about three thousand feet high runs parallel to the coast at a distance of some thirty miles inland. Through this the Kugura River breaks after heading among the higher peaks beyond. As seen from a distance, the nearer range does not seem to have suffered intense glaciation. It certainly was not covered by an ice cap; but small glaciers may have occupied the valleys on the north side. The presence of a piedmont glacier is not improbable. The deep cut of the Kugura, however, in its rounded outline has a heavily glaciated look, and it is here that we must look for the source of the ice that forms our island.

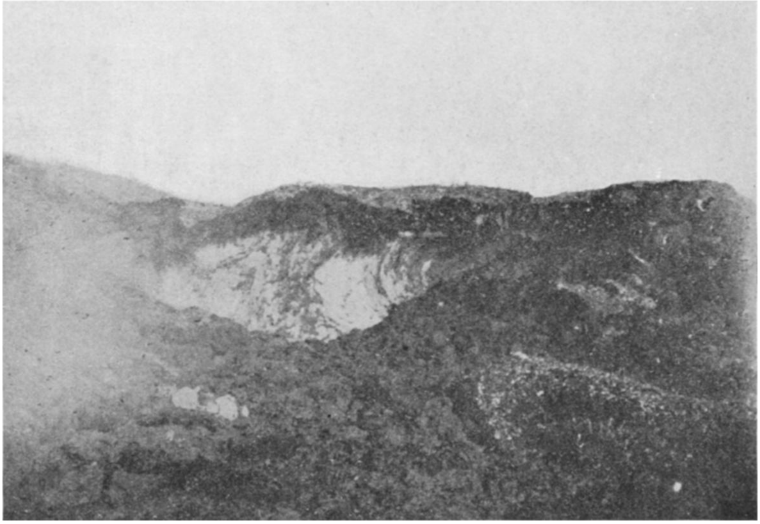

FIG. 3.—A characteristic exposure.

In his report on the Koyukuk, John, Anaktuvuk, and Coville

Rivers, Schrader[1] deals at some length with the glaciation of the region.

> The glacial phenomena that have been described tend to show that, although the Endicotte Mountains do not on the whole seem to have been overridden by a moving ice cap, they were doubtless, especially in the northern part, largely occupied by an ice cap or perennial nevé constituting a breeding-ground for glaciers.

The mountains he traversed reached an elevation of between five and six thousand feet and he found no living glaciers, yet a heavy body of ice pushed northward along the valley of the Coville. Around the headwaters of the Kugura elevations of over seven thousand occur, and valley glaciers[2] of considerable size are reported to exist. Taking these things into consideration, it is to be expected that the basin of the Kugura would be occupied by a glacier of sufficient magnitude to push thirty miles beyond the mountains and reach the sea.

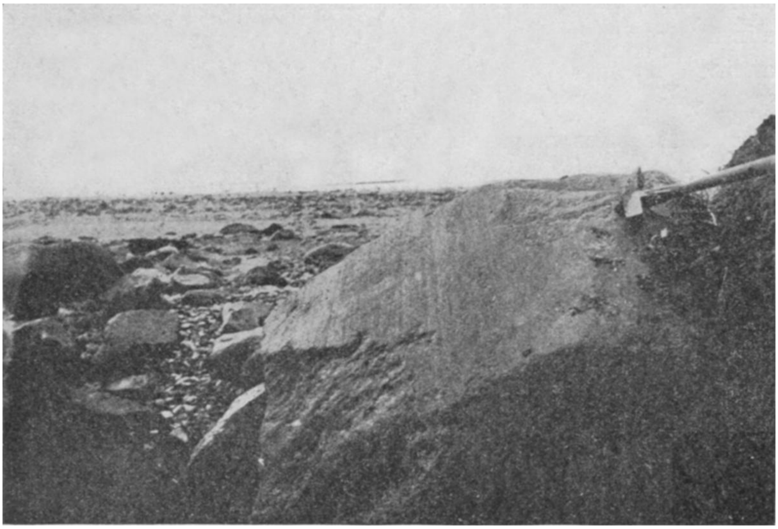

FIG. 4.—A striated boulder on the island.

The presence of ground ice a few feet below the surface of the tundra is a characteristic feature of the Arctic coastal plain. Dall[3] is of the opinion that it is a widespread phenomenon, but Schrader[4] doubts its general occurrence. However widespread it may ultimately prove to be, it is certainly an interesting feature. Schrader's theory[1] is that the ground ice is the result of "frozen bays, lagoons, lakelets, or perhaps other coastal bodies of ponded water now raised into low anticlines and cut back by wave action." The localities visited by him were Capes Simpson and Halkett, between Point Barrow and the Coville River. Here the ice evidently was not glacial, for boulders are not known to exist on the beach west of Flaxman Island. An inquiry into the presence of air bubbles or granulation would soon settle the question as to whether the ground ice in that region could be accounted for by the freezing of bodies of standing water.

---

[1] *Op. cit.*, p. 91.

[2] Schrader, *op. cit.*, p. 30.

[3] W. H. Dall, "Correlation Papers," *Bull. U. S. Geological Survey*, No. 84, p. 92.

[4] *Op. cit.*, p. 92.

The writer believes that he has shown that the ground ice at Flaxman Island is of glacial origin. Its occurrence there is very similar to that of the same formation elsewhere, in that it closely underlies the tundra along the mud cliffs which are such a common feature on the northern shore of Alaska. If future investigation shows that the ice could have resulted from the freezing of bodies of standing water, the explanation given by Schrader seems the most probable one. But if it is granulated, the writer is of the opinion that its history will be found to be connected with that of the region during the glacial period. The following hypothesis is suggested:

At present the coastal plain is free from snow scarcely three months in the year. During the glacial period the snow did not entirely disappear during the short summer, but accumulated in favorable localities. As the climate grew warmer, silt was brought down by the mountain streams and distributed over the ice by the wind. Moss and grass quickly took root and increased the thickness by the formation of peat. Wherever this covering reached a sufficient depth the ice was prevented from melting and has remained until the present day. Where the thickness was insufficient, the ice melted leaving the depressions which are now occupied by the ponds and lakes which are such a characteristic feature of the tundra.[2]

The temperature of the plain adjacent to the Arctic Ocean is kept in the neighborhood of freezing by the presence of the ice-laden waters. Inland the temperature is much higher. Schrader[1] reports the water of the Coville as being 52° F. near where it leaves the mountains. Consequently not only would the accumulation of snow be greater near the coast, but the subsequent melting less. The ground ice should therefore be confined to a narrow belt along the coast.

---

[1] *Op. cit.*, p. 96.

[2] Schrader, *op. cit.*, p. 46.

October 15, 1906

[1] *Op. cit.*, p. 129.